

# Comparison of occupational exposure assessment tools and concepts for nanomaterials

**Liguori, Biase; Baun, Anders; Hansen, Steffen Foss; Alstrup Jensen, Keld**

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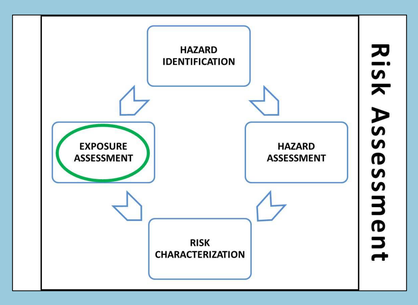
# Comparison of Occupational Exposure Assessment Tools and Concepts for Nanomaterials

**Biase Liguori*, Anders Baun, Steffen Foss Hansen, Keld Alstrup Jensen,**
***biasl@env.dtu.dk**

## Introduction

- Increasing use of engineered nanomaterials comes the accompanying risk of greater exposure in the work environment




- Determining the potential exposure risk is difficult because of lack of data on nanomaterial exposure levels
- Various Control Banding (CB) tools are available, but understanding of when and how they should be applied and their pros and cons is limited

## Methodology

Step 1: We identified a range of CB tools: *NanoSafer*, *ANSES*, *Stoffenmanager Nano*, the *Swiss Precautionary Matrix*, *Control Banding Nanotool* and *IVAM Guidance*

Step 2: We analyzed each CB tools specifically in regard to:

- the domain of application – does it accounts for nanospecific factor?
- the work exposure scenario - for which types of processes can they be used?
- the input data requirements for the hazard and exposure bands – what data is required and is that available?
- Does the tool rely on qualitative and/or quantitative exposure evaluations?
- Is the final output qualitative or semi-quantitative or quantitative?

## Results – Hazard Banding

Hazard band allocation is found to be dependent on the input parameters taken into consideration by the tools. Figure 1 is a graphical representation of bands allocated by each tool.

Band allocation reflects the developers choices on how dynamic the tool can be. Scale allocation to the bands can be:

- Directly associated to the input parameter
- Function of more different input parameters

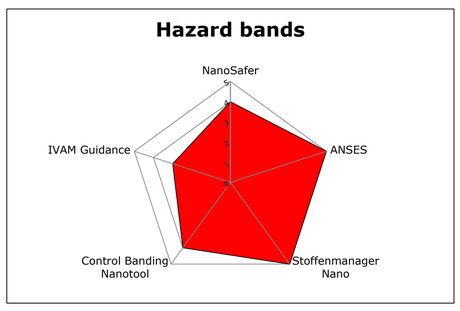



Figure 1: Graphical presentation of the number of bands allocated by the tools. Precautionary Matrix is not represented in this chart because of is different approach can't be properly categorize as a "conventional" Control Banding tool

## Results – Exposure Banding

Exposure band allocation is generally a function of different parameters including emission rates/potential and contextual information. Figure 2 is a graphical representation of bands allocated by the tools. Which reflects the developers choices on how dynamic the tool can be.

- Some tools (NanoSafer, Stoffenmanager Nano) taking into account the near field and the far field
- Others (e.g. ANSES directly allocate scaling value in relation to the physical form of the nanomaterial

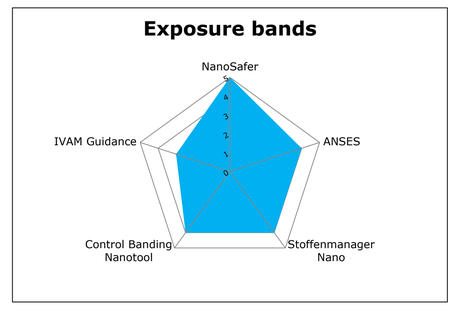



Figure 2: Graphical presentation of the number of bands allocated by the tools. Precautionary Matrix is not represented in this chart because of is different approach can't be properly categorize as a "conventional" Control Banding tool

## Results – Input parameters/Evaluation/Outcome

| | NANOSAFER | ANSES | STOFFENMANAGER NANO | PRECAUTIONARY MATRIX | CONTROL BANDING NANOTOOL | IVAM GUIDANCE |
|---|---|---|---|---|---|---|
| **INPUT PARAMETERS** | Similar to Stoffenmanager Nano. Focus on **contextual information** on the working environment taking into account input related to: emission rate, dustiness, activity energy, moisture, ventilation rate, separation. | Focus on the **physical form** of the materials according to Hansen classification (Hansen et al., 2007) and whether the matrix is likely to release particles under low stress. | Similar to NanoSafer. Focus on **contextual information** on the working environment taking into account input related to: emission rate, dustiness, activity energy, moisture, ventilation rate, separation. | Physical form like in ANSES. Some contextual information relatively to the **amount handled per day**, the amount to which workers are potentially exposed and the frequency of handling. | **Amount handled during the task**, dustiness, number of employee exposed, frequency of operation, duration of operation. | Contextual working environment focusing on the type of **activities**, the place of the activity in the production and possibility of exposure during the activities |
| **EVALUATION METHOD** | EQUATION | BINARY | EQUATION | EQUATION | SUM OF SCORES | SUM OF SCORES |
| **OUTCOME** | Qualitative | Qualitative | Qualitative | Qualitative | Qualitative | Qualitative |
| | Recommendation and action that should be taken into consideration. | General recommendation | Ranging priority of needed action | Suggesting if there is or not a need for an action | General recommendation | General recommendation and reference to hierarchic Occupational Hygienic |
| | 5 bands | 4 bands | 4 bands | n.a. | 4 bands | 3 bands |

Table 1: This table is presenting an overview of the Control Banding tools relatively to the exposure assessment input parameters; the evaluation method and the outcome.

## Conclusion

CB tools have different intended use which makes comparison hard,

- Control Banding Nanotool = for Lawrene Livermore National Laboratory; NanoSafer = for Small Medium enterprise; PP Matrix = Establish thresholds of implementing risk reducing measures

There is difference of input parameters used by the tools even when they choose the same parameter class,

- Precautionary Matrix = Amount of handled per day; Control Banding Nanotool = Amount of handled during the task; NanoSafer = Amount of powder handled / Amount of handled in each transfer

Fundamental difference between CB tools that use an internal exposure approach and an external exposure approach, respectively

Comparative analysis of scope, domain, input- and output-parameters might not really be fair

Comparative testing are necessary for further assessment and understanding the possibilities for combination of CB tools